Thermal Baseline Patterns on Psychiatric Patients and Staff

BRUNO M. KAPPES AND ROBERT C. MORRIS
University of Alaska
Anchorage, Alaska

This project originated as a norm study to provide information on temperature variations prior to establishing treatment programs for psychiatric patients. A sample of 116 volunteers (59 patients and 57 staff members) participated in a 20-minute baseline study at a large psychiatric hospital. Finger skin temperature on both hands for both groups typically increased 3 to 4°F without feedback. Male temperatures were higher than female temperatures overall and over time. Female staff produced the lowest temperatures when compared to female patients or males in both groups. Patients obtained higher temperatures when compared to staff. Male and female patient temperatures were almost identical, which is atypical and inconsistent with previous reports on sex differences. This result may have been influenced by medication, because patients receiving antipsychotic medication produced higher overall temperatures. Finally, a race effect suggests various ethnic groups may obtain overall thermal differences during baseline.

Clinical biofeedback has rapidly become a major area of behavioral medicine. Several hospitals and private clinics use various biofeedback modalities as an adjunct to other types of therapy for the treatment of many psychosomatic and physical dysfunctions (Miller, 1975). One frequent modality, temperature biofeedback, involves training in the self-regulation of finger skin temperature to facilitate a generalized state of relaxation, a reduction of anxiety, and specifically the control of migraine headaches (Russell, 1972; Sargent, Green & Walters, 1972).

While there has been a host of literature supporting the therapeutic effects of skin temperature regulation, many research reports continually indicate the need for adequate baseline periods to distinguish specific learning effects from random fluctuations (Taub & Emurian, 1973, 1976; Taub, Emurian & Howell, 1974; Taub & School, 1978). Moreover, there exists evidence of sex differences between subjects initially for baseline and also during training (Kappes, 1978; Trusk & Jankel, 1979; Breitbart, 1979). Aside from these influences, artifacts like ambient room temperature (Packer, 1980), person factor or experimenter effect (Taub, 1977), and the effects of suggestion (Herzfeld & Taub, 1977, 1980) may also contribute to inaccurate assessment of valid training effects. The significance of these artifacts and other influences on temperature biofeedback training supports the need for controlled research on baselines for various clinical and nonclinical populations in their respective settings. The present study examined baseline temperature readings on both hands for psychiatric patients and staff. This project originated as a norm study to provide information on temperature variations prior to establishing treatment programs for psychiatric patients. It was particularly important to observe the specific effects of variables like age, sex, race, diagnostic classification, type of medication, height, weight, and room temperature on baseline skin temperature for psychiatric patients as compared to the psychiatric staff in the same hospital environment.

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Method

Subjects

A sample of 116 psychiatric patients and staff volunteers from a large psychiatric hospital participated in what was announced as a study to develop biofeedback norms in a hospital setting. The sample consisted of 59 patients (40 males, 19 females) and 57 staff members (23 males, 34 females) with mean ages and age ranges of 32 (17-76) and 34 (19-63) respectively.

The patient group was classified by: race (White, Black, and Eskimo), diagnoses (psychotic, nonpsychotic), and medication (antipsychotic, other medication). Since the staff was quite homogeneous with respect to race (White, N = 53, Nonwhite, N = 4), and since only two staff members reported taking any medication, no further biodemographic analyses of staff were warranted. (See Table 1 for patient biodemographics and respective sample sizes.)

Procedure

Each subject consented to one 30-minute appointment between the hours of 10:00 a.m. and 3:00 p.m., excluding 12:00 a.m. to 1:30 p.m. Thus, eight subjects were tested daily, Monday through Friday. The study was conducted over a six-week period with data collected every other week. Subjects were requested not to eat, drink, smoke or exercise one hour prior to their appointment. All testing was conducted in a small conference room at a local psychiatric hospital. The room temperature was recorded once for every subject at the beginning of their session. Room temperature remained stable at 74 °F ± 1 °.

There were four experimenters. Two males and two females were counterbalanced over time of day. Each experimenter followed the same procedure for each session. Staff and patients were interspersed as much as possible throughout the session times available. Patients and staff were contacted in the morning, and appointments were made for that particular day. A typical session went as follows: first, patients or staff members were either escorted or arrived on their own, and their height and weight were measured; secondly, each subject was instructed to be seated in a straight-backed chair while the experimenter attached two thermistors, one to the middle finger of each hand. Subjects were requested to place both hands upright in their lap. The temperature monitor and experimenter were directly behind the subject, and readings were recorded every 2, 5, 10, 15, and 20 minutes. Calibration of monitor was checked prior to each session. Sex, hand dominance, room temperature, height, weight, and whether a subject smoked were recorded on data sheets at the time of testing. All other confidential data concerning diagnosis, type of medication, race, and age were obtained from hospital records.

Apparatus

Hand temperatures were measured by a Digitec thermometer, model no. 5820, manufactured by United Systems Corporation. This instrument features a Fahrenheit display with a range of −32. °F to +199.9 °F. The established accuracy is within +/−0.5 °F.

Two temperature probes (model 709A manufactured by Yellow Springs Instrument Co.) were selected to measure surface skin temperatures. These thermistors have suggested temperature limits of -22 °F to +212 °F and are compatible with Digitec monitor.

Results

An analysis of covariance for repeated measures, with room temperature as a covariate and interval measurements for both hands as a repeated measure, was used to assess the effects of sex, group, experimenters' sex, time (intervals), and hand on finger skin temperature.

The analysis of covariance revealed three significant main effects: time, group, and sex of subject. The analysis also resulted in four significant interactions: sex by

Table 1

Overall Means and Standard Deviations of Hand Temperatures on Patient Variables

Variable	N	°F $\bar{X}$	°F SD
Race			
White	33	92.1	5.1
Eskimo	18	95.4	1.5
Black	5	93.4	2.7
Not Available	3		
Diagnoses			
Psychotic	38	93.8	4.7
Schizophrenic Disorder	26		
Psychotic Disorder	8		
Organic Brain Syndrome	4		
Nonpsychotic	19	92.4	5.4
Neurotic Diagnoses	9		
Affective Disorder	5		
Adjustment Reaction	3		
Personality Disorder	2		
Not Available	2		
Medication			
Antipsychotic	39	94.0	3.8
Haldol	12		
Navane	8		
Thorazine	7		
Mellaril	5		
Stelazine	4		
Prolixin	3		
Other Meds.	14	91.4	5.2
Lithium	5		
Elavil	3		
Dilantin	2		
Vivactil	1		
Sinequan	1		
Thiamine	1		
Multivitamins	1		
Not Available	6		

group, time by group, time by sex, and time by group by sex. The covariate, room temperature, was also significantly correlated with hand temperatures when both groups were combined. However, independent correlational analyses on each group found room temperature to be significantly correlated with hand temperature for

Table 2

Overall Hand Temperature Means and Standard Deviations by Sex For Patients and Staff

Sex	$n^a n^b n^c$	Staff		Patients		Combined	
		X	SD	X	SD	X	SD
		°Fahrenheit[d]					
Males	23,40(63)	94.0	1.7	93.5	3.7	93.7	3.1
Females	34,19(53)	88.3	6.8	93.2	5.3	90.1	6.7
Both	57,59(116)	90.6	6.0	93.4	4.2	92.0	5.3

NOTE. Means and Standard Deviations are unadjusted and represent left and right hands combined.

[a]Staff only

[b]Patients only

[c]Staff and patients combined

[d]Celcius = (Fahrenheit - 32) X .5556

staff only ($r = .46$, $p. < .001$). Patients' hand temperatures were not related to room temperature ($r = .01$, $p. > .10$).

First, the time main effect indicated finger skin temperature increased significantly over a 20-minute period for both groups, $F(4, 432) = 27.96$, $p < .001$. Typically, subjects increased finger temperatures, on the average, three to four degrees Fahrenheit during baseline with no feedback.

Secondly, the results revealed a significant overall difference between groups, $F(1, 107) = 4.65$, $p < .05$, and a group difference over time, $F(4, 423) = 9.48$, $p < .001$. Patients obtained significantly higher baseline temperatures overall and across repeated intervals when compared to staff members.

The third main effect demonstrated significant sex differences overall, $F(1, 107) = 8.21$, $p < .01$, and over the 20-minute baseline period, $F(4, 432) = 4.82$ $p < .01$. Male finger skin temperatures were significantly higher than female temperatures overall and over time.

The sex and group main effects should be treated cautiously since a sex by group interaction found female staff members to have obtained significantly lower temperatures overall when compared to female patients or males in both groups $F(1, 107) = 6.00$, $p < .001$. This finding was also significant over time, $F(4, 432) = 9.00$, $p < .001$. (See Table 2 and Figure 1.)

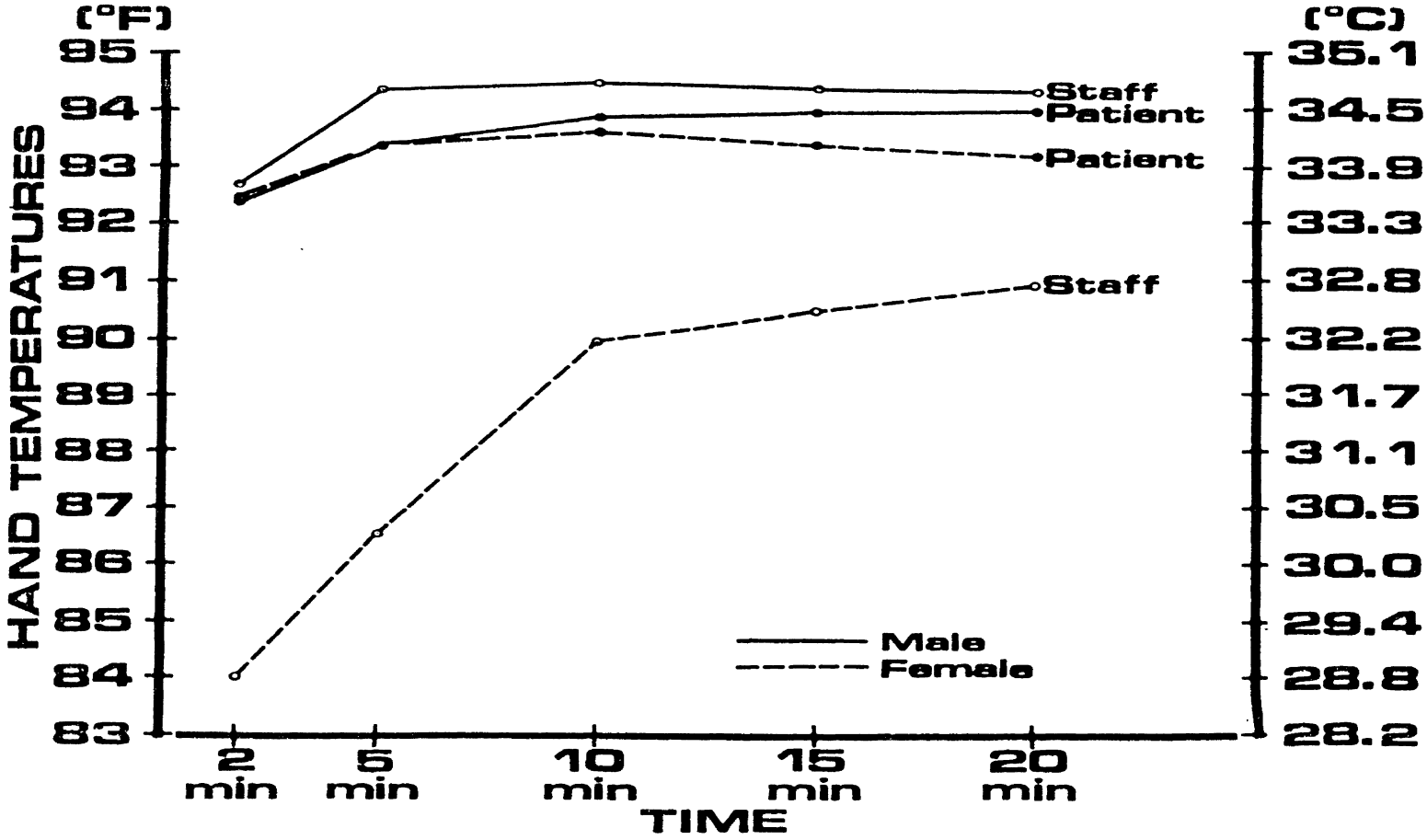

Figure 1. Mean temperatures by sex by group over time.

A three-way analysis of variance was conducted on the effects of race, diagnosis, and medication of psychiatric patients. The results revealed a significant race main effect, $F(2, 45) = 4.35$, $p<.02$. Newman-Keuls post hoc comparisons indicated that overall temperatures for White patients were significantly lower than for Eskimo patients, $F(1, 53) = 4.21$, $p<.05$. Black patients were not significantly different from Eskimo patients, $F(1, 53) = .578$, $p>.10$ or White patients, $F(1, 53) = .204$, $p>.10$.

Diagnosis was not significant, $F(1, 45) = 1.68$, $p>.10$, however, a drug main effect indicated that patients receiving antipsychotic medication displayed significantly higher temperatures than patients with other medication, $F(1, 45) = 4.52$, $p<.05$.

Finally, experimenters' sex was not significant, $F(1,107) = 2.42$, $p<.05$, and neither was hand dominance, $F(1, 108) = .66$, $p<.05$. Baseline readings were not substantially influenced by sex of experimenter or hand preference of the subject. Likewise, age, height, and weight were not significantly correlated with hand temperatures for both groups, except staff's age, which was negatively correlated with hand temperature readings ($r = -.45$, $p<.01$). Older staff members produced cooler hand temperatures.

Discussion

There are several issues raised from the results of this study. First, finger skin temperature increased 3 to 4 °F from a mere 20 minutes of immobility, which

suggests the need for initial stabilization periods prior to beginning biofeedback training. Although this issue has been previously discussed in other reports (Packer, 1980; Taub, 1977), there still remains no standard baseline interval to make clinical studies comparable. A 20-minute period in this study was adequate for stabilization, since temperature variance was substantially reduced and apparently approached stability. Longer baselines of surface skin temperature have consistently shown a "drift effect," the tendency of skin temperature to move towards the temperature of the room over time (Yates, 1980). Clinicians and researchers wanting to minimize the influences of room temperature on skin temperature might follow these guidelines: train clients in the same room and at the same time of day; use an adequate baseline of 15 to 20 minutes (Sdorow, Palladino, Cook, Lashinsky, Mazzocco & Williams, 1979); and use change scores for each session (Taub, 1976).

Secondly, the results revealed psychiatric patients obtained considerably higher temperatures than the staff as a whole. These staff/patient differences may have been a direct result of medication for the following reasons: 1) patients receiving antipsychotic medication displayed significantly higher temperatures than patients on other medications, and the majority of patients were taking antipsychotic medication; 2) room temperatures were significantly related to skin temperatures for staff ($r = 46$), but not for patients ($r = .01$); 3) male and female patient temperatures were almost identical, which is atypical and inconsistent with previous reports on sex differences (Kappes, 1978; Packer, 1980; Trusk et al., 1979). These findings support the view that medication, particularly antipsychotic medication, may reduce "normal" variability, thus resulting in high and relatively stable temperature values. Temperature biofeedback may not be the best modality for psychiatric patients receiving antipsychotic medication since little variance can be expected and temperature approaches a ceiling.

The main sex difference, regardless of group, must be treated cautiously. Although it was apparent that males in both groups obtained higher temperatures than females in both groups, a subsequent interaction clearly indicated female staff had displayed the lowest temperature values. In fact, these low temperature values actually forced the female patient mean to be lower when averaged across sex. It is likely female patients without medication would have temperatures similar to female staff, however, this requires further investigation. It has been hypothesized that male and female differences simply result from anatomical differences, i.e., males having superficial veins originating closer to the skin (Puhl & Golding, 1975). Some clinicians contend that many females are frequently cardiovascular responders and typically suffer from Raynaud's more often than men. These speculations also require further research.

Finally, a race difference suggests various ethnic groups may obtain overall temperature differences. Eskimos in this study showed significantly higher temperature values than did Whites. Blacks were not significantly different from Whites or Eskimos. Since very few Blacks were available, it is difficult to generalize beyond this group.

These ethnic differences are relevant to cross-cultural research studies. Physical anthropologists are keenly aware of anthropometric variations of body parameters as a result of geographic habitat. Future research might examine other ethnic groups as well as consider psychophysiological differences within our own geographic regions.

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